

REMARKS

Claims 1, 8, 23, 26 and 30 have been amended and claims 14-22, 33, 35-57, 63-65, 69, 72-97, 100 and 103-106 have been cancelled without prejudice. Accordingly, claims 1-13, 23-32, 58-62, 66-68, 70-71, 98-99 and 101-102 are currently pending.

I. Amendments:

Claims 1 and 8 have been amended to recite that the silica-based material is selected from the group consisting of silica-based sols, fumed silica, silica gels, precipitated silicas, acidified solutions of alkali metal silicates and suspensions of silica-containing clays of smectite-type; and that the metal salt is based on an alkali metal or alkaline earth metal and has an anion selected from the group consisting of hydroxide, borate, nitrate, chloride, formate and acetate. Support for amended claim 1 can be found in the specification at page 3, lines 19-23 and at page 6, lines 6-9. No new matter has been added.

Claims 23 and 26 have been amended to be consistent with amended claim 1, with respect to the silica-based material. Again, no new matter has been added.

Claim 30 has been amended to clarify that the recited "%" is by weight. Support for amended claim 30 can be found in the specification at page 6, lines 24-25. No new matter has been added.

II. The Invention:

The invention is directed to aqueous polysilicate microgels and a process for preparing same, which allows for the preparation of high-concentration polysilicate microgels with high stability. The polysilicate microgels are particularly useful as drainage/dewatering aids.

III. Objections/Rejections:**Objections:**

On page 3 of the Office Action, claims 63 and 69 were objected to as being of improper dependent form. As claims 63 and 69 have been cancelled, it is respectfully submitted that the objection is now moot and should be withdrawn.

On page 4 of the Office Action, claims 15-17, 22 and 66 were objected to as dependent on claim 14, which is part of the unfavorable decision to applicants. As claims 15-17 and 22 have been cancelled, it is respectfully submitted that the objection is now moot with respect to these claims. As claim 66 depends from independent claim 23, it is respectfully submitted that the objection is improper. Accordingly, applicants respectfully request that the objection be withdrawn.

Rejections:

On page 4 of the Office Action, claim 30 was rejected under 35 U.S.C. 112, second paragraph, as being indefinite because the basis of the "%" was not specified. As claim 30 was amended to specify that the "%" is by weight, it is respectfully requested that this rejection be withdrawn.

On pages 4-6 of the Office Action, claims 1-2, 4-9, 11-13, 23-24, 26-27, 29, 31-32, 58-61, 63, 66-67 and 69-71 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as allegedly being obvious over U.S. Patent No. 2,727,008 to Iler ("Iler"). This rejection is respectfully traversed.

Iler discloses a process for preparing an aqueous silica sol which comprises mixing a silica sol of relatively low concentration with an alkali metal silicate solution of higher silica concentration (column 1, lines 67-70, example 1). Nowhere does Iler disclose adding a metal salt which is based on an alkali metal or alkaline earth metal and has an anion selected from the group consisting of hydroxide, borate,

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nitrate, chloride, formate and acetate, to an aqueous solution of alkali metal silicate and an aqueous phase of silica-based material, in a process for preparing an aqueous polysilicate microgel, as presently claimed.

The Office Action contends that Iler discloses that the products were tested by titrating between pH of 4 to 9 with sodium hydroxide and that the sodium hydroxide is a metal salt other than aluminium. However, Iler discloses that "An attempt was made to determine the surface area of the silica particles in the final sol produced by a pH titration technique." (emphasis added) See col. 5, lines 62-64. It is clear that sodium hydroxide is only used for testing the final silica sol and not at all during the preparation of the silica sol. Accordingly, applicants respectfully submit that the disclosed titration step has nothing to do with the preparation method or the final sol product.

Moreover, there is no disclosure that the titrated material would be in the form of a stable polysilicate microgel. In that regard, Iler teaches that the silica sols obtained by the process of the invention, which includes the step of removing alkali metal ions, is in a metastable state and that raising the pH into the range of 5 to 7 will cause the resulting sols to become unstable and readily gel. See col. 4, lines 61-65. Thus, there is no motivation by one skilled in the art to add a metal salt in order to achieve a stable microgel, in accordance with the presently claimed process. To the contrary, Iler actually teaches away from such a process. Consequently, the present invention claimed in claims 1 and 8 is not anticipated or rendered obvious by Iler.

Iler also fails to anticipate or render obvious independent claim 23. Iler discloses an initial silica sol and a method for concentrating the sol. In Example 1, the initial sol was prepared by passing a sodium silicate through an ion-exchange column. The effluent was collected in 200 ml increments, the first 400 ml being

discarded; all the remaining fractions which were collected had a pH less than 3.5 (column 5, lines 30-34). It is further stated that the removal of alkali metal ions causes the pH to drop rapidly. The sol is quite unstable in a pH range of 5 to 7 (as discussed above) and hence, the alkali metal ions are removed rapidly to lower the pH below 5 and preferably below 4 (See col. 3, line 72-col. 4, line 4). Accordingly, it is respectfully submitted that not only does Iler fail to disclose the claimed microgel, but actually teaches away from the present invention according to claim 23, in which the claimed pH range of the aqueous silica-based material is of from 6.5 to 11.

Iler also discloses sodium silicate solutions having weight ratios of 1.95 and 3.25 of $\text{SiO}_2:\text{M}_2\text{O}$, where M is alkali metal. However, Iler is completely silent as to the molar ratio of $\text{SiO}_2:\text{M}_2\text{O}$ of the silica sol obtained. Iler discloses that the sodium silicate solution is added to the initial silica sol. The resulting mixture is passed through an ion exchange column (c.f. column 5, lines 38-62). The aim of the ion-exchange process is to remove Na^+ -ions. Therefore, since both the initial silica sol and the final silica sol obtained are passed through ion-exchange column, the molar ratio of $\text{SiO}_2:\text{M}_2\text{O}$ will not inherently be within the claimed range of the present invention. Accordingly, applicants respectfully submit that the present invention claimed in claim 26 is not anticipated or rendered obvious by Iler.

Therefore, it respectfully requested that the rejections under 35 U.S.C. 102(b), or alternatively under 35 U.S.C. 103(a), in view of Iler be withdrawn.

On pages 6-7 of the Office Action, claims 1, 4-6, 8-9, 11-12, 15, 17, 22-24, 26-27, 29-30, 32, 58-63, 66-71, 98-99 and 101-102 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as allegedly being obvious over U.S. Patent No. 5,116,418 to Kaliski ("Kaliski"). This rejection is respectfully traversed.

Kaliski discloses mixing very fine particle kaolin clay slurry with an aqueous sodium silicate and calcium chloride to form complex functional microgel. Kaliski is completely silent about a silica-based material which is selected from the group consisting of silica-based sols, fumed silica, silica gels, precipitated silicas, acidified solutions of alkali metal silicates and suspensions of silica-containing clays of smectite-type. Kaolin (kaolinite) belongs to the Kaolinite Group of minerals and is a distinct material from the above-mentioned groups. A copy of the definition of clay mineral groups at <http://www.galleries.com/minerals/silicate/clays.htm> is enclosed for the convenience of the Examiner.

Kaliski is also completely silent about an aqueous phase of silica-based material having a pH within a range of from 6.5 to 11. Further, Kaliski is silent about the molar ratio of $\text{SiO}_2:\text{M}_2\text{O}$ between 3:1 and 20:1 in the microgel obtained.

Therefore, it is respectfully requested that the rejections under 35 U.S.C. 102(b), or alternatively under 35 U.S.C. 103(a), in view of Kaliski be withdrawn.

On page 7-8 of the Office Action, claims 1, 2, 4-9, 11-13, 15, 17, 22-24, 26, 27, 29-32, 58-63, 66-71, 98, 99 and 101-102 were provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-21 of copending Application No. 10/007,885.

Claims 1 and 22-40 are the currently pending claims in copending Application No. 10/007,885. Moreover, applicants respectfully submit that the aqueous sol according to claim 1 (of that application) is patentably distinct from the claims of the present invention.

Therefore, applicants respectfully request that the rejection based on copending Application No. 10/007,885 be withdrawn.

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IV. Conclusion:

Applicants respectfully submit that the application as amended, including claims 1-13, 23-32, 58-62, 66-68, 70-71, 98-99 and 101-102, is now in proper form for allowance, which action is earnestly solicited. If resolution of any remaining issue is required, the Examiner is invited to contact applicants' undersigned attorney at the telephone number provided below.

Respectfully submitted,



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Enc. The Clay Mineral Group website printout

THE CLAY MINERAL GROUP

The clay minerals are a part of a general but important group within the **phyllosilicates** that contain large percentages of water trapped between the silicate sheets. Most clays are chemically and structurally analogous to other phyllosilicates but contain varying amounts of water and allow more substitution of their cations. There are many important uses and considerations of clay minerals. They are used in manufacturing, drilling, construction and paper production. They have great importance to crop production as clays are a significant component of soils.

It is the physical characteristics of clays that more so than the chemical and structural characteristics define this group:

- Clay minerals tend to form microscopic to sub microscopic crystals.
- They can absorb water or lose water from simple humidity changes.
- When mixed with limited amounts of water, clays become plastic and are able to be molded and formed in ways that most people are familiar with as children's clay.
- When water is absorbed, clays will often expand as the water fills the spaces between the stacked silicate layers.
- Due to the absorption of water, the specific gravity of clays is highly variable and is lowered with increased water content.
- The hardness of clays is difficult to determine due to the microscopic nature of the crystals, but actual hardness is usually between 2 - 3 and many clays give a hardness of 1 in field tests.
- Clays tend to form from weathering and secondary sedimentary processes with only a few examples of clays forming in primary igneous or metamorphic environments.
- Clays are rarely found separately and are usually mixed not only with other clays but with microscopic crystals of **carbonates, feldspars, micas and quartz**.

Clay minerals are divided into four major groups. These are the important clay mineral groups:

The Kaolinite Group

This group has three members (**kaolinite, dickite and nacrite**) and a formula of $Al_2Si_2O_5(OH)_4$. The different minerals are polymorphs, meaning that they have the same chemistry but different structures (polymorph = many forms). The general structure of the kaolinite group is composed of silicate sheets (Si_2O_5) bonded to aluminum oxide/hydroxide layers ($Al_2(OH)_4$) called **gibbsite** layers. The silicate and gibbsite layers are tightly bonded together with only weak bonding existing between the **s-g** paired layers.

Uses: In ceramics, as a filler for paint, rubber and plastics and the largest

THE CLAY GROUP

Side 2 av 3

use is in the paper industry that uses kaolinite to produce a glossy paper such as is used in most magazines.

The Montmorillonite/Smectite Group

This group is composed of several minerals including **pyrophyllite, talc, vermiculite, sauscelite, saponite, nontronite and montmorillonite**. They differ mostly in chemical content. The general formula is $(Ca, Na, H)(Al, Mg, Fe, Zn)_2(Si, Al)4O_{10}(OH)_2 - xH_2O$, where x represents the variable amount of water that members of this group could contain. Talc's formula, for example, is $Mg_3Si_4O_{10}(OH)_2$. The gibbsite layers of the kaolinite group can be replaced in this group by a similar layer that is analogous to the oxide **brucite**, $(Mg_2(OH)_4)$. The structure of this group is composed of silicate layers sandwiching a gibbsite (or brucite) layer in between, in an **s-g-s** stacking sequence. The variable amounts of water molecules would lie between the **s-g-s** sandwiches.

Uses: Are many and include a facial powder (talc), filler for paints and rubbers, an electrical, heat and acid resistant porcelain, in drilling muds and as a plasticizer in molding sands and other materials.

The Illite (or The Clay-mica) Group

This group is basically a hydrated microscopic **muscovite**. The mineral **illite** is the only common mineral represented, however it is a significant rock forming mineral being a main component of shales and other argillaceous rocks. The general formula is $(K, H)Al_2(Si, Al)4O_{10}(OH)_2 - xH_2O$, where x represents the variable amount of water that this group could contain. The structure of this group is similar to the montmorillonite group with silicate layers sandwiching a gibbsite-like layer in between, in an **s-g-s** stacking sequence. The variable amounts of water molecules would lie between the **s-g-s** sandwiches as well as the potassium ions.

Uses: A common constituent in shales and is used as a filler and in some drilling muds.

The Chlorite Group

This group is not always considered a part of the clays and is sometimes left alone as a separate group within the phyllosilicates. It is a relatively large and common group although its members are not well known. These are some of the recognized members:

- **Amesite** $(Mg, Fe)_4Al_4Si_2O_{10}(OH)_8$
- **Baileychlorite** $(Zn, Fe+2, Al, Mg)_6(Al, Si)_4O_{10}(O, OH)_8$
- **Chamosite** $(Fe, Mg)_3Fe_3AlSi_3O_{10}(OH)_8$
- **Clinochlorite (kaemmererite)** $(Fe, Mg)_3Fe_3AlSi_3O_{10}(OH)_8$
- **Cookeite** $LiAl_5Si_3O_{10}(OH)_8$
- **Corundophilite** $(Mg, Fe, Al)_6(Al, Si)_4O_{10}(OH)_8$
- **Daphnite** $(Fe, Mg)_3(Fe, Al)_3(Al, Si)_4O_{10}(OH)_8$
- **Delessite** $(Mg, Fe+2, Fe+3, Al)_6(Al, Si)_4O_{10}(O, OH)_8$
- **Gonyerite** $(Mn, Mg)_5(Fe+3)_2Si_3O_{10}(OH)_8$
- **Nimite** $(Ni, Mg, Fe, Al)_6AlSi_3O_{10}(OH)_8$
- **Odinite** $(Al, Fe+2, Fe+3, Mg)_5(Al, Si)_4O_{10}(O, OH)_8$

- **Orthochamosite** $(\text{Fe}^{+2}, \text{Mg}, \text{Fe}^{+3})_5\text{Al}_2\text{Si}_3\text{O}_{10}(\text{O}, \text{OH})_8$
- **Penninite** $(\text{Mg}, \text{Fe}, \text{Al})_6(\text{Al}, \text{Si})_4\text{O}_{10}(\text{OH})_8$
- **Pannantite** $(\text{Mn}, \text{Al})_6(\text{Al}, \text{Si})_4\text{O}_{10}(\text{OH})_8$
- **Rhipidolite (prochlorite)** $(\text{Mg}, \text{Fe}, \text{Al})_6(\text{Al}, \text{Si})_4\text{O}_{10}(\text{OH})_8$
- **Sudoite** $(\text{Mg}, \text{Fe}, \text{Al})_4 - 5(\text{Al}, \text{Si})_4\text{O}_{10}(\text{OH})_8$
- **Thuringite** $(\text{Fe}^{+2}, \text{Fe}^{+3}, \text{Mg})_6(\text{Al}, \text{Si})_4\text{O}_{10}(\text{O}, \text{OH})_8$

The term **chlorite** is used to denote any member of this group when differentiation between the different members is not possible. The general formula is $\text{X}_4\text{-}\text{Y}_4\text{O}_{10}(\text{OH}, \text{O})_8$. The X represents either aluminum, iron, lithium, magnesium, manganese, nickel, zinc or rarely chromium. The Y represents either aluminum, silicon, boron or iron but mostly aluminum and silicon.

The gibbsite layers of the other clay groups are replaced in the chlorites by a similar layer that is analogous to the oxide **brucite**. The structure of this group is composed of silicate layers sandwiching a brucite or brucite-like layer in between, in an **s-b-s** stacking sequence similar to the above groups. However, in the chlorites, there is an extra weakly bonded brucite layer in between the **s-b-s** sandwiches. This gives the structure an **s-b-s b s-b-s b** sequence. The variable amounts of water molecules would lie between the **s-b-s** sandwiches and the brucite layers.

Uses: No industrial uses.

Some minerals listed above (specifically chlorite, pyrophyllite and talc) as belonging to one of the clay groups are often excluded by some mineralogists. Usually the reason is that their crystal size and character do not consistently conform to those parameters that define a clay. Such minerals are listed here more for their structural similarities, however all three minerals are quite often found associated with and do behave like clays occasionally.

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